Bonneville Power Administration
Fish and Wildlife Program FY99 Proposal

Section 1. General administrative information

Upper Yakima Species Interactions Studies

Bonneville project number, if an ongoing project 9506402

Business name of agency, institution or organization requesting funding
Washington Department of Fish and Wildlife

Business acronym (if appropriate) WDFW

Proposal contact person or principal investigator:

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Subcontractors.

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NPPC Program Measure Number(s) which this project addresses.
7.4K; 2.2A, 2.2H; 7.2D

NMFS Biological Opinion Number(s) which this project addresses.

Other planning document references.
Wy Kan Ush Me Wa Kush Wit, Volume II, p. 59 and Table SP4; Columbia River Fish Management Plan, Appendix B; Columbia Basin System Planning Salmon and Steelhead Production Plan, Yakima River Subbasin, p. 104

Subbasin.
Yakima River

Short description.
Establish the baseline status of key species; implement experiments to help define the competitive and ecological interactions that may occur among supplemented and non-target species, identify key risks and implement monitoring procedures.

Section 2. Key words

Mark	Programmatic Categories	Mark	Activities	Mark	Project Types
X	Anadromous fish		Construction		Watershed
+	Resident fish		O & M		Biodiversity/genetics
	Wildlife		Production	+	Population dynamics
	Oceans/estuaries	+	Research	+	Ecosystems
	Climate	X	Monitoring/eval.		Flow/survival
	Other		Resource mgmt		Fish disease
			Planning/admin.	X	Supplementation
			Enforcement		Wildlife habitat en-
			Acquisitions		hancement/restoration

Other keywords.
Ecological interactions, competition, predation, ecological risk assessment, ecological risk containment, risk containment monitoring.

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship
9506404	WDFW Policy/Technical Involvement and Planning for YKFP	Provides for WDFW policy and technical planning and coordination for the project. Sets goals and objectives for monitoring and evaluation.
9506406	Monitoring of Supplementation Response Variables for the YKFP	Provides lead position in development of the YKFP Monitoring Implementation Plan and implements M & E for long-term fitness and reproductive success response variables
9506405	Further Development of the "NIT" and "LNIT" Strategies for the YKFP	Provides field testing and final definition of the new innovative treatments to be used for fish rearing to produce individuals with traits similar to their wild counterparts
8812001	YIN Yakima/Klickitat Project	Privides for YIN policy and technical

	Management	planning and coordination for the Project. Sets goals and objectives for monitoring and evalution
9701300	Yakima Cle Elum Hatchery O&M	Operation of the experimental hatchery to test the assumption that supplementation is an effective rebuilding approach
9506300	Yakima/Klickitat Monitoring & Evaluation Program	Implements portions of the supplementation evaluation as described by the Upper Yakima Spring Chinook Monitoring and Evaluation Plan

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Assess and monitor rearing characteristics of target and non-target species of concern	a	Determine the density, distribution, and size structure of rainbow trout in tributaries and mainstem sections and determine the abundance of associated species and environmental conditions
		b	jDetermine the density, distribution, and size structure of westslope cutthroat trout in tributaries and mainstem ssections and determine the abundance of associated species and environmental conditions
		c	Determine the density, distribution, and size structure of bull trout in the North Fork of the Teanaway River and determine the abundance of associated species and environmental conditions.
		d	Determine the density, distribution, and size structure of spring chinook salmon in tributaries and mainstem sections and determine the abundance of

			associated species and environmental conditions
		e	Determine the density, distribution, and size structure of other non-target taxa of concern and determine the abundance of associated species and environmental conditions
		f	Determine the most appropriate analytical tools to monitor the density, distribution, and size structure of non-target taxa of concer
2	Establish and estimate a fish predation index in the spring chinook migration corridor	a	Determine smolt predation index of predators in standardized stream sections and known "hot spots"
3	Participate in the refinement of the YKFP monitoring plan	a	Refine portions of the YKFP monitoring plan associated with ecological risk containment, ecological interactions, and natural production and review other monitoring plan components.

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	10/1998	9/1999	55.00%
2	10/1998	9/1999	25.00%
3	10/1998	9/1999	20.00%
			TOTAL 100.00%

Schedule constraints.

Completion date.
2005

Section 5. Budget

FY99 budget by line item

Item	Note	FY99
Personnel		$230,000
Fringe benefits		$60,000
Supplies, materials, non-expendable property		$31,435
Operations & maintenance		$3,000
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		$5,000
PIT tags	# of tags:	
Travel		$6,700
Indirect costs		$63,865
Subcontracts		
Other		
TOTAL		$400,000

Outyear costs

Outyear costs	FY2000	FY01	FY02	FY03
Total budget	$400,000	$400,000	$400,000	$400,000
O&M as % of total	0.75%	0.75%	0.75%	0.75%

Section 6. Abstract

This ongoing task is one of an integrated suite of tasks which, collectively, implement the Yakima/Klickitat Fisheries Project (YKFP). The goal of the YKFP is to test the assumption that supplementation can be used to restore natural production and increase harvest opportunities while keeping genetic and ecological impacts within specified limits, as stipulated by the Northwest Power Planning Council (Measure 7.4K). This task establishes the baseline status of resident trout, steelhead, and spring chinook salmon and associated species and implements experiments to help define the competitive and ecological interactions that may occur between non-target taxa and supplemented anadromous species. Key risk factors are identified in the context of target and non-target species objectives and monitoring procedures and plans are developed and implemented to assess ecological responses to supplementation. The goals, objectives, and tasks of this project are developed and described by a multi-disciplinary team of scientists, the Monitoring and Evaluation Planning Team (MIPT). The supplementation monitoring framework is provided in the Upper Yakima Spring Chinook Monitoring Plan (Busack, et al., 1997; hard copy attached).

Section 7. Project description

a. Technical and/or scientific background.

Species interactions research was initiated in the Yakima subbasin in 1989 to investigate ecological interactions among fish in reponse to proposed supplementation of salmon and steelhead in the upper Yakima River basin. The need for a strong ecological interactions component in the Yakima/Klickitat Fisheries Project was identified by the Northwest Power Planning Council in their response to the Yakima and Klickitat Rivers Central Outplanting Facility Master Plan (1987). The PPC approved the master plan for the YKFP as a "reasonable basis upon which the BPA may proceed to fund predesign work" while identifying eight tasks to be completed prior to final approval for construction of the project. Among these tasks was to develop a refined goals statement with particular attention to protection of native anadromous and resident stocks. In August, 1990 the PCC gave conditional approval to proceed with the final design phase of the YKFP but , to avoid placing remaining wild/natural substocks of salmon and steelhead at excessive risk, they instructed the Species Interactions Study to include spring chinook in their study and to provide additional clarity on the acceptable level of impacts to non-target species from hatchery-reared salmon and steelhead.

During the ensuing years, data have been collected prior to supplementation to characterize the rainbow trout and other fish populations such as steelhead and spring chinook salmon. In addition, experimental work has been done to predict the potential interactions that may occur as a result of supplementation, and develop methods to monitor interactions between supplemented and non-supplemented species (reviewed in Pearsons et al, 1994).

The project activities to date have provided the requisite information for the development of an ecological risk assessment and risk containment plan associated with supplementing steelhead trout and spring chinook salmon in the upper Yakima basin. The ecological risk approach includes five steps. First, management objectives for non-target species are determined. Second, ecological risks would be assessed with respect to non-target species objectives. Third, protocols of hatchery supplementation would be reviewed and refined (if necessary) to minimize undesirable interactions. Fourth, a monitoring plan would be developed and implemented to measure the extent to which non-target species objectives are achieved. Finally, alterations to existing operations would be recommended if deviations from non-target species objectives are achieved.

Continuation of these activities is proposed for 1998-1999 in order to improve baseline information on wild salmonids supportive to YKFP planning, and to further investigate species interactions among target and non-target fishes. Results and methods from previous work have been communicated in six annual reports (Hindman et al, 1991, McMichael et al. 1992, Pearsons et al. 1993, Pearsons et al. 1994, Pearsons et al. 1996, Pearsons et al. 1997) and six peer-reviewed publications (McMichael 1993, Martin et al.

1995, McMichael et al. 1997, McMichael and Pearsons In Press, McMichael et al. In Press, Pearsons et al. In Press).

b. Proposal objectives.

Objective 1: Monitor Rearing Characteristics of Target Species and Non-target Species of Concern

Continue collection of baseline information about the distribution, density, and size structure of rainbow trout and other non-target taxa so that a monitoring plan can be developed and implemented. These NTTOC include bull trout, westslope cutthroat trout, Pacific lamprey, mountain sucker, sand roller, leopard dace, and mountain whitefish. A total of 33 index sites in 12 creeks have been established in previous work. It is extremely important to continue baseline monitoring of non-target taxa because management objectives are stated in terms of deviations from stated objectives. (See Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan pp. 114-120 and 126-128 for detailed protocols).

Objective 2: Establish and estimate a fish predation index in the spring chinook migration corridor.

Predation Indices (PIs) will be developed to guage each predator/prey interaction monitored. Predators will be sample during seasons and at times of day when predation can be expected to occur at maximal rates. Separate indices will be developed for fish, birds, and mammals (See Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan pp. 95-103 and 120-122 for detailed protocols).

Objective 3: Participate in the refinement of the YKFP monitoring plan

Participate as a member of the YKFP Monitoring Implementation Planning Team and serve as the team expert on ecological interactions. Scientists from WDFW and YIN work together to develop and refine a monitoring and risk containment plan for the YKFP. The plan will be updated with refined operational details, power analyses and sample size detail. (See Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan).

c. Rationale and significance to Regional Programs.

The Yakima/Klickitat Fisheries Project was identified in the 1982 Columbia River Basin Fish and Wildlife Program (Measure 704(i)(3) and 904(e)(1). A draft Master Plan was presented to the Power Planning Council in 1987 and the Preliminary Design Report in 1990. In both cases the PPC instructed the managers (the YIN and the WDFW) to carry out planning functions that addressed project uncertainties in several topical areas including the risk of ecological impacts posed by supplementation of anadromous species in the Yakima river basin. Ecological Interactions is one of four major response variables

to be monitored over the life of the upper Yakima spring chinook supplementation project, including the impact of strong effectors on the success of supplementation and the effect of supplemented salmonids on non-target taxa of concern. The objectives and tasks described herein are called for in the Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan. Results from ecological interactions work as well as other facets of the YKFP are designed to provide transferrable information to be used throughout the region. Project scientists believe this project to be unique in having been designed from its inception to test the efficacy of supplementation while keeping genetic and ecological impacts within specified limits.

The cooperating fishery managers on the YKFP are the Yakama Indian Nation and the Washington Department of Fish and Wildlife. A project management framework stipulates that project management is directed by a Policy Group consisting of representatives of the fishery managers. The USBOR is an interested party in the basin and several proposed monitoring facilities are operated by BOR. BPA is the funding entity and has the lead responsibility for NEPA document development and compliance.

d. Project history

Previous project number: 89-105

Project reports and technical papers: See section 7g.

Summary of major results achieved: This project has assessed and described characteristics of rainbow trout spawning activity in the mainstem and tributaries of the Yakima River above Roza Dam; developed a biological profile of resident trout spawning populations in tributaries and mainstem; estimated spatial and temporal overlap with resident trout, steelhead, and spring chinook; characterized the distribution and abundance of resident trout and spring chinook rearing; experimentally assessed potential for impacts of hatchery steelhead and spring chinook on resident rainbow trout, developed draft objectives for non-target of concern; devised an ecological risk assessment matrix; initiated predator index feasibilty work in the spring chinook migration corridor; and developed a monitoring plan to assess ecological interactions associated with supplementation.

Adaptive Management Implications: The data gathered from baseline development and experimentation will be used to identify key ecological response indicators to be monitored and evaluated following introduction of supplementation fish as part of the YKFP adaptive management risk containment process.

Under the adaptive management structure for the YKFP, project managers propose actions (strategies) in response to a set of agreed-upon objectives. These actions are designed as experiments to test whether the predicted result (or some other result) occurs. They also define operating assumptions needed to accept the strategies, associated uncertainties, and the risk of not meeting the stated objectives if the assumptions are

incorrect or the strategy is not feasible. The experiments must be carefully designed to obtain valid (i.e., statistically reliable) results in a specified period of time. The experiments are conducted and carefully monitored to allow statistical evaluation of the results. The process includes a mechanism for review of the previous year's results, which may cause the objectives to be modified, in turn restarting the process.

Years Underway: 1989 – present; 1996 – present with current project number.

Past Costs: $852,905 (FY'96 + FY'97)

e. Methods.

The overall goals of the WDFW species interactions research is to assess the potential for YKFP supplementation activities to impact non-target taxa of concern (NTTOC) in the Yakima Riveer basin, to gather information on NTTOC necessary for monitoring their status, to monitor and contain undesirable ecological impacts, to assess the potential for fish predators to limit the success of the YKFP supplementation program, and to develop methods for monitoring supplementation success. Species that will receive particular attention in this project period include resident trout (rainbow, cutthroat, and bull trout), steelhead, spring chinook salmon, Pacific lamprey, mountain whitefish, mountain sucker, leopard dace, smallmouth bass, channel catfish, and northern squawfish.

Objective 1: Assess and monitor rearing characteristics of target and non-target species of concern.

Task a: Determine the density, distribution, and size structure of rainbow trout in tributaries and mainstem sections and determine the abundance of associated species and environmental conditions.

Using backpack electrofishing units, rainbow trout and their associated species will be sampled in 33 established 200 m long tributary index sites during the summer and fall. Multiple removal methods similar to previous years work will be used to calcualte population methods. Environmental conditions such as temperature, discharge, channel unit composition, and habitat complexity will be measured in the index sites. Using a driftboat electrofishing unit, rainbow trout and their associated species will be sampled in five established mainstem Yakima river index sites.

Task b: Determine the density, distribution, and size structure of westslope cutthroat trout in tributaries and mainstem sections and determine the abundance of associated species and environmental conditions.

Using backpack electrofishing units, westslope cutthroat trout and their associated species will be sample in 22 established 200 m long tributary index sites during the summer and fall. Every salmonid will be weighed and measured. Species associated with cutthroat will be counted and weighed. Environmental conditions such as

temperature, discharge, channel unit composition and habitat complexity will be measured in the index sites.

Task c: Determine the density, distribution, and size structure of bull trout in the North Fork of the Teanaway River and determine the abundance of associated species and environmental conditions.

Snorkel all habitats in the known areas of bull trout distribution in the North Fork of the Teanaway River during July and August. All species that are observed will be counted and assigned to age class. Environmental conditions such as channel unit type and depth will be qualitatively described in the area where each bull trout is observed. Density and size structure of bull trout in two 200 m index sites in the North Fork of the Teanaway River will be available from Objective 1a and 1b.

Task d: Determine the density, distribution, and size structure of spring chinook salmon in tributaries and mainstem sections and determine the abundance of associated species and environmental conditions.

Using backpack electrofishing units, spring chinook salmon and their associated species will be sampled in 18 established 200 m long tributaary index sites during the summer and fall. Species associated with spring chinook will be counted and weighed. Environmental conditions such as temperature, discharge, channel unit composition and habitat complexity will be meassured in the index sites.

Using a driftboat electrofishing unit, a sample (i.e., approximately 200 per section or 1000 fish) of spring chinook salmon will be collected furing rainbow trout poopulation estimates is five mainstem Yakima River index sites during the fall. The relative abundance of juvenile spring chinook salmon will be determined in five mainstem sections that are sampled to determine rainbow trout abundance.

Task e: Determine the density, distribution, and size structure of other non-target taxa of concern and determine the abundance of associated species and environmental conditions.

Snorkeling and electrofishing methods will be used to sample other non-target taxa of concern and other associated species. We will continue to sample for sand roller, leopard dace, mountain sucker, and Pacific lamprey in reaches that historically contained these fish.

Task f: Determine the most appropriate analytical tools to monitor the density, distribution, and size structure of NTTOC.

Various analytical tools will be explored to determine the most statistically powerful and biologically meaningful way to monitor NTTOC. Some species, such as rainbow trout, have extensive baseline data associated with them whereas others, such as bull trout, don't. Models that help explain variation in monitoring variables will be

explored to increase statistical power. Variables include water chemistry, benthic invertebrate density, flow, temperature, etc. Power analyses will be performed on all NTTOC. A power analysis x ecological risk x uncertainty matrix will be developed to facilitate decision making about what statistical power is acceptable given different levels of ecological risk. (Results of power analysis modelling can be examined in Pearsons et al 1998, in preparation).

Task g: Disseminate results of Objective 1a – f.

Results of work conducted between 1990 and 1999 will be communicated in three ways; digitally, orally, and in writing. Density of NTTOC and relative abundance of associated species data collected during population estimates will be sent to STREAMNET. An annual report incorporating all of the tasks will be submitted to BPA by March 1, 2000. At least two manuscripts resulting from Objective 1 work will be submitted to scientific journals for publication during the fiscal year.

Discussion

For some NTTOC the deficiency of baseline data, small sample sizes, or high natural variation will preclude the detection of impacts as small as proposed. In such cases, the ability to detect and contain ecological risks will be low, and the merit of the project must be weighed against the risk of failing to meet the the NTTOC objective. For example, the objective for pacific lamprey is zero impact, but impacts may not be statistically detectable until they reach 75%. Completion of task f will allow us to make statement about the power of monitoring and analytical approaches.

Objective 2: Establish and estimate a fish predation index in the spring chinook corridor.

Task a: Determine smolt predation index of predators in standardized stream sections and know “hot spots”.

Smallmouth bass, northern squawfish, and channel catfish inhabit the lower Yakima River and have been shown to be substantial predators in other areas of the Columbia basin. The predation index developed by Ward et al. (1995) or a slightly modified version (i.e. accounting for differences in species specific evacuation rates; Vigg et al. 1991) will be calcualted at the time of peak and last quartile of spring chinook salmon migration. The predation index requires an index of abundance, water temperature, mean weight of the predator, mean number of spring chinook salmon in each gut, and mean weight of the gut contents. Therefore, three main activities will be necessary 1) calculate abundance index in index areas, 2) collect stomach contents, and 3) analyze stomach contents in the lab.

Discussion

Predation feasibility work during 1997 demonstrated that predator densities were high enough in index areas to warrant further work. However, maximum likellihood estimates were overestimated because marked fish were moving into or out of our index areas. Furthermore, summer estimates appeared to be inappropriate measure of predator abundance in the spring because population estimates were quite different between the summer and spring due to fish moving between the Columbia and Yakima rivers. In addition, capture techniques must be refined due to species-specific vulnerability to different gears. Continuing feasibility work during 1998 is designed to refine these techniques and work planned for 1999 is dependent upon resolution of these uncertainties.

Objective 3: Participate in the development of the YKFP monitoring plan.

Task a: Refine portions of the YKFP monitorng plan associated with ecological risk containment, ecological interactions, and natural production and review other monitorng plan components.

The YSIS will be responsible for developing components of the monitoring plan associated with non-target taxa of concern, ecological interactions, and natural production of spring chinook salmon.

f. Facilities and equipment.

The Species Interactions Study project has been in place for eight years and has an adequate basic inventory of field sampling gear such as rafts, dry suits, smolt traps, boat and backpack electrofishing gear, computers, etc. The projected annual budgets reflect historic expenditures and anticpate periodic upkeep and replacement as various gear reaches the end of its usefulness. The staff is housed in the WDFW district office in Ellensburg and has access to adequate office and shop space.

g. References.

1994 Columbia River Basin Fish and Wildlife Program, Northwest Power Planning Council, Portland OR. 1994

1982 Columbia River Basin Fish and Wildlife Program, Northwest Power Planning Council, Portland,OR. 1982

Morris Brusett, Chairman Northwest Power Planning Council; letter to Jame Jura, Administrator, Bonneville Power Administration, November 10, 1987, Attachment 2.

Tom Truelove, Chairman Northwest Power Planning Council; letter to Joseph Blum, Director, Washington Department of Fisheries, August 9, 1990.

Busack, C., B. Watson, T. Pearsons, C. Knudsen, Phelps, S., and M. Johnson. 1997. Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan. 185 pp.

Hindman, J. N., G. A. McMichael, J. P. Olson, and S. A. Leider. 1991. Yakima River Species Interactions Studies. Annual Report FY 1990 submitted to Bonneville Power Administration, Portland, Oregon. DOE/BP-01483-1. 75 pp.

McMichael, G. A., J. P. Olson, E. L. Bartrand, M. Fischer, J. N. Hindman, and S. A. Leider. 1992. Yakima River Species Interactions Studies. Annual Report FY 1991 submitted to Bonneville Power Administration, Portland, Oregon. DOE/BP-01483-2. 177 pp.

Pearsons, T. N., G. A. McMichael, E. L. Bartrand, M. Fischer, J. T. Monahan, and S. A. Leider. 1993. Yakima Species Interactions Study. Annual Report FY 1992 submitted to Bonneville Power Administration, Portland, Oregon. DOE/BP-01483-3. 98 pp.

Pearsons, T. N., G. A. McMichael, S. W. Martin, E. L. Bartrand, M. Fischer, and S. A. Leider. 1994. Yakima River Species Interactions Studies. Annual Report FY 1993 submitted to Bonneville Power Administration, Portland, Oregon. DOE/BP-99852-2. 247 pp.

Pearsons, T. N., G. A. McMichael, S. W. Martin, E. L. Bartrand, J. A. Long, and S. A. Leider. 1996. Yakima River Species Interactions Studies. Annual Report FY 1994 submitted to Bonneville Power Administration, Portland, Oregon. DOE/BP-99852-3. 150 pp.

Pearsons, T. N., G. A. McMichael, E. L. Bartrand, A. L. Fritts, K. D. Ham, and C. W. Hopley. Yakima River Species Interactions Studies. Annual Report FY 1995-1996 submitted to Bonneville Power Adminstration, Portland, Oregon. 96AT65513. In Preparation.

McMichael, G. A. 1993. Examination of electrofishing injury and short-term mortality in hatchery rainbow trout. North American Journal of Fisheries Management 13:229-233.

Martin, S. W., J. A. Long, and T. N. Pearsons. 1995. Comparison of survival, gonad development, and growth between rainbow trout with and without surgically implanted dummy radio transmitters. North American Journal of Fisheries Management 15:494-498.

McMichael, G. A., C. S. Sharpe, and T. N. Pearsons. 1997. Effects of residual hatchery-reared steelhead on growth of wild rainbow trout and spring chinook salmon. Transactions of the American Fisheries Society 126:230-239.

Vigg, D. L., T. P. Poe, L. A. Prendergast, and H. C. Hansel. 1995. Rates of consumption of juvenile salmonids and alternative prey fish by northern squawfish, walleyes, smallmouth bass, and channel catfish in John day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:421-438.

Ward, D. L., J. H. Petersen, and J. J. Lock. 1995. Index of predatioin on juvenile salmonids by northern squawfish in the lower and middle Columbia River and in the lower Snake River. Transactions of the American Fisheries Society 124:321-334.

Section 8. Relationships to other projects

This project is one among a suite of integrated projects that, collectively, constitute the Yakima/Klickitat Fisheries Project. Projects 9506404 and 8812001 provide policy and technical planning and coordination for the Washington Department of Fish and Wildlife and the Yakama Indian Nation, respectively. The Policy Group receives technical input from the Scientific and Technical Advisory Committee (STAC), also supported under the above contract numbers. Project 9506402 , 9506405, 9701300, 9506300, 8812008, and 8812005 each represent a critical component of the Yakima/Klickitat Fisheries Project, addressing critical uncertainties as reflected in the Project Status Report, Vol. 3, Yakima Spring Chinook Salmon (1995) and the Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan (1997).

Section 9. Key personnel

Todd N. Pearsons, PhD. Fish Biologist 4 12 mos Principal Investigator

Todd is the project leader and the project specialist on ecological interactions. He supervises three staff biologists and up to five scientific technicians. He plans, directs, and evaluates complex species interaction research in the Yakima River, including baseline data collection, analysis and monitoring, and specific experiments that test appropriate hypotheses. He serves on the Monitoring Implementation Planning Team as the specialist is ecological interactions, developing major portions of the YKFP monitoring plan. His has been in this role for two and one half years and has been the leader of the Species Interactions Study for seven years.

Geoff A.McMichael Fish Biologist 3 12 mos Ecological Risk Assessment

Geoff specializes in developing techniques to assess sources of ecological risk within the Yakima/Klickitat Fisheries Project. He is responsible for assessment of species interactions among resident trout, anadromous salmonids, and non-target species, as well as assessment of ecological risks to fishes associated with sampling methods. He has been a key biologist on the project for eigth years.

Kenneth D. Ham PhD Fish Biologist 3 12 mos Ecological Risk Containment

Kenneth manages (plans, organizes, coordinates, evaluates, and implements) the ecological risk containment aspect of the project. He specializes in developing monitoring protocols for ecological risk containment, including power analysis and modelling. Kenneth has been with the project for almost two years.

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BACKGROUND

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1986-1992:	Graduate Research Assistant, Oregon State University
1989-1994:	Ph.D., Fisheries Science, Oregon State University
1986-1989:	M.S., Fisheries Science, Oregon State University
1981-1985:	B.S., Aquatic Biology, Univ. of California, Santa Barbara

SELECTED PUBLICATIONS

McMichael, G. A., and T. N. Pearsons. In Press. Effects of wild juvenile spring chinook salmon on growth and abundance of wild rainbow trout. Transactions of the American Fisheries Society. March 1998.

McMichael, G. A., T. N. Pearsons, and S. A. Leider. In Press. Minimizing ecological impacts of hatchery-reared juvenile steelhead on wild salmonids in a Yakima basin watershed *In* E. E. Knudsen, editor, Proceedings of the Toward Sustainable Fisheries Conference,. Ann Arbor Press, Michigan. 1998.

McMichael, G. A., C. S. Sharpe, and T. N. Pearsons. 1997. Effects of residual hatchery-reared steelhead on growth of wild rainbow trout and spring chinook salmon. Transactions of the American Fisheries Society 126:230-239.

Pearsons, T. N., G.A. McMichael, S. W. Martin, E. L. Bartrand, J. Long, and S.A. Leider. 1994. Yakima River species interactions studies: Annual report 1994. Washington Department of Fish and Wildlife, Olympia, Washington. BPA, Portland,DOE/BP99852-3

Pearsons, T.N., H.W. Li, and G.A. Lamberti. 1992. Influence of habitat complexity on resistance to flooding and resilience of stream fish assemblages. Transactions of the American Fisheries Society 121:427-436.

Busack, C., B. Watson, T. Pearsons, C. Knudsen, S. Phelps, M. Johnston. 1997. Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan. Unpubli. Report for Yakima Fisheries Project.

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BACKGROUND

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1987-1989: M.S., Fish & Wildlife Mgt., Montana State University
1983-1987: B.S., Fish & Wildlife Mgt., Montana State University

SELECTED PUBLICATIONS

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1996-present:	Fish and Wildlife Biologist, Washington Department of Fish and Wildlife
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1990-1994:	Ph.D. Ecology, University of Tennessee.
1986-1989:	M.S. Wildlife and Fisheries Sciences, Texas A&M University.
1982-1986:	B.S. Wildlife and Fisheries Sciences, University of Tennessee.

SELECTED PUBLICATIONS

Ham, K.D., K.O. Winemiller, and K.A. Rose. submitted. Distribution of Life History Strategies in Northern Lake Fish Communities.

Adams, S.M., K.D. Ham, and R.F. LeHew. In press. A framework for evaluating organism responses to multiple stressors: mechanisms of effect and importance of modifying ecological factors. In: J.J. Cech and B.W. Wilson (eds.), Multiple Stresses in Ecosystems. Lewis Publishers, Boca Raton, FL.

Ham, K.D., S.M. Adams, and M.J. Peterson. 1997. Application of multiple bioindicators to differentiate spatial and temporal variability from the effects of contaminant exposure on fish. Ecotoxicology and Environmental Safety 37:53-61.

Adams, S.M., K.D. Ham, R.F. LeHew, and C.F. Saylor. 1996. Downstream gradients in bioindicator responses: point source contaminant effects on fish health. Canadian Journal of Fisheries and Aquatic Sciences 53:2177-2187

Adams, S.M., K.D. Ham, and J.J. Beauchamp. 1994. Application of canonical variate analysis in the evaluation and presentation of multivariate biological response data. Environmental Toxicology and Chemistry 13:1673-1683.

Section 10. Information/technology transfer

Results of work will be communicated in three ways; digitally, orally, and in writing. Density of NTTOC and relative abundace of associated species data collected during population estimates will be formatted and sent to STREAMNET and to the YKFP archive repository. Oral presentations will be made to resource groups and schools upon request, YKFP, BPA, and WDFW management meetings, and at scientific meetings. An annual report incorporating all the tasks in this project will be submitted to BPA by March 1, 2000. Finally, at least two mauscripts resulting Objective 1 will be submitted to scientific journals for publication during the fiscal year.